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GRAPHICS SOFTWARE FOR DATA ANALYSIS:

IV. BIVARIATE PLOT PROGRAM - USER'S GUIDE

by

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I. INTRODUCTION

I.1. PURPOSE

The Bivariate Plot program is an interactive program which produces bivariate statistics and plots. The results of data processing are displayed on the computer screen and may be copied to both an electrostatic copier and a plotter. An annotated bivariate plot is drawn according to the user's specifications.

1.2. INPUT DATA

Data are presented to the program in a sequential pair of data files: a Header file and a Data file. Both files are written in binary format and are produced by the ASCII-to-BINARY translator program.(*) The Header file contains a description of the Data file, which follows the Header file immediately on the storage unit.

1.3. OUTPUT

Primary output is displayed on the computer screen. This output consists of information retrieved from the input data, user instructions and the annotated bivariate plots.

An electrostatic copy of the screen content may be obtained under program control or by pressing the "MAKE COPY" button on the Tektronix 4051 keyboard.

A pen-plotted version of the bivariate plot may be obtained under program control. Options for setting the shape and width of the plot are available.

(*) see second report from the same series: II. DATA TRANSFER AND DATA FILE MANAGEMENT - USER'S GUIDE.

1.4. HARDWARE CONSTRAINTS

The Bivariate Plot program described in this report is written in BASIC and runs on a TEKTRONIX 4051 graphics computer with 32K core memory. Data input may be from the internal magnetic tape drive or another storage unit such as a disk-drive or a RAM mass-storage unit.(*)

The electrostatic copier is the Tektronix Hard Copy Unit 4611. The plotter used is the Tektronix 4662 Plotter.

The program will also run on any upward-compatible hardware from the same manufacturer.

1.5. SOFTWARE DESIGN

Although this report is a User's Guide, the design of the program is given here so that writing a computer program producing similar outputs will be relatively easy for potential users who do not have access to the hardware on which this particular program runs (see section 1.4 above).

A copy of the program may be obtained on request by those who can access a Tektronix graphics computer of the 4050 series.

The general design of the Bivariate Plot program is presented in Figure 1. More details are given for each component in Figure 2.

(*) A RAM mass-storage unit, called the 'Auxiliary Memory Module' in the text, is used at SRC.

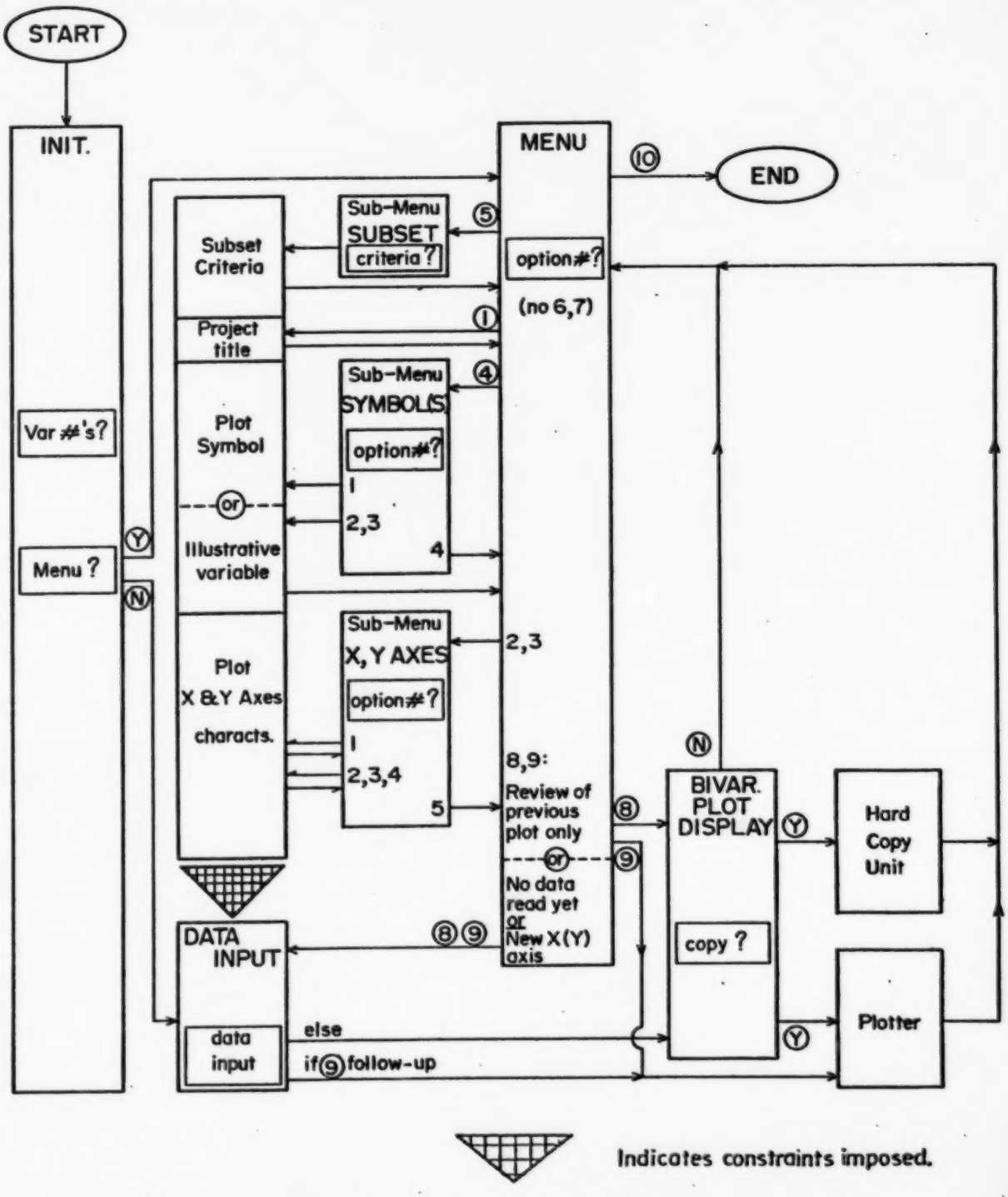
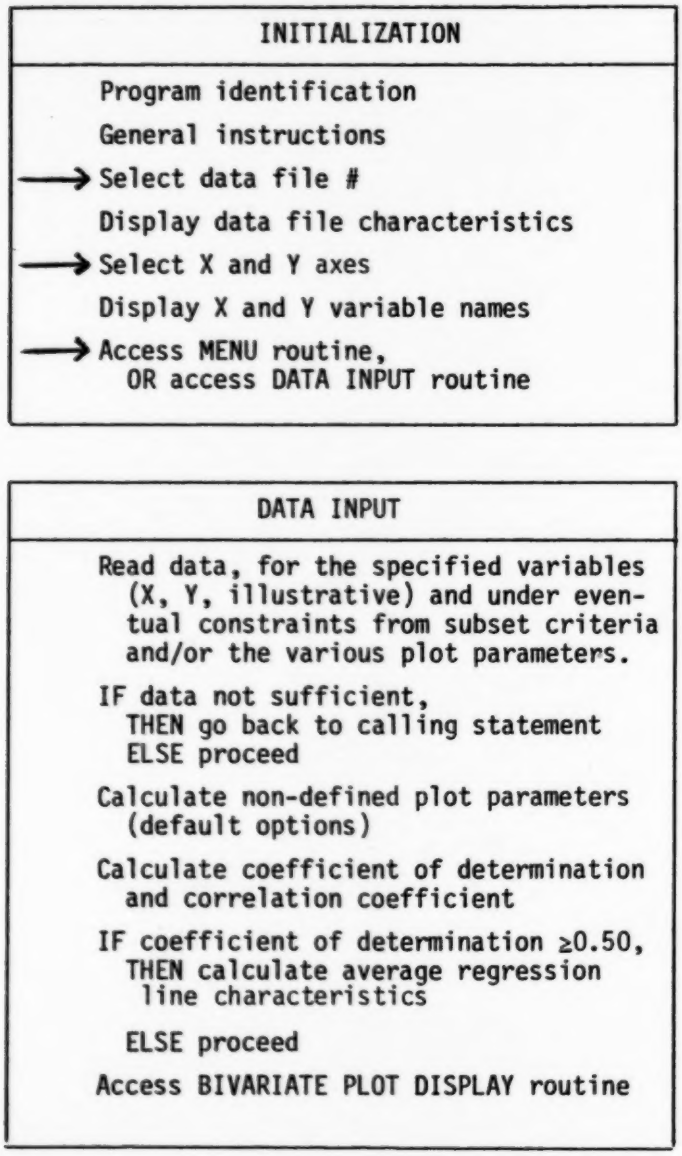
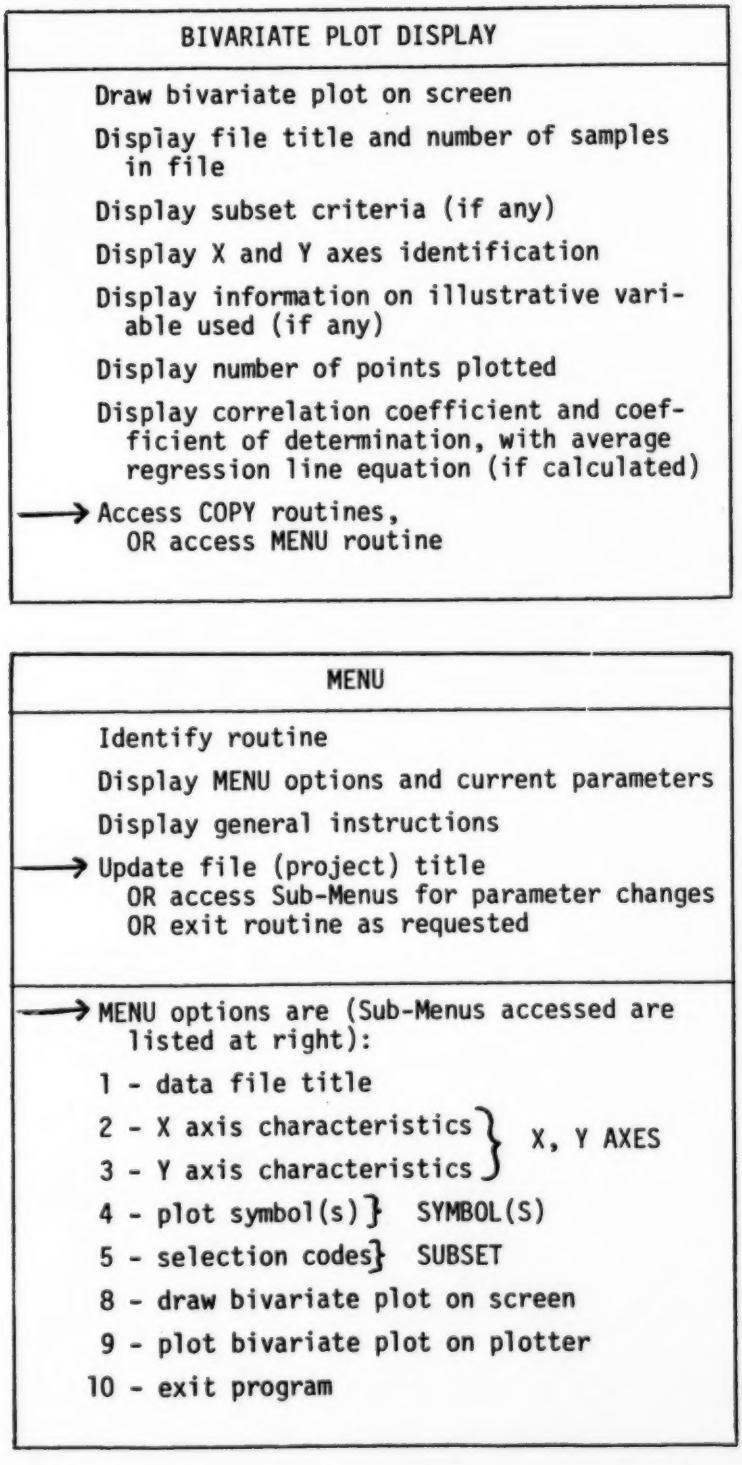


Figure 1. General software design for the BIVARIATE PLOT program. See Figure 2 for details on each routine.


INITIALIZATION
Program identification
General instructions
Select data file #
Display data file characteristics
Select X and Y axes
Display X and Y variable names
Access MENU routine,
OR access DATA INPUT routine
DATA INPUT
Read data, for the specified variables (X, Y, illustrative) and under eventual constraints from subset criteria and/or the various plot parameters.
IF data not sufficient,
THEN go back to calling statement
ELSE proceed
Calculate non-defined plot parameters (default options)
Calculate coefficient of determination and correlation coefficient
IF coefficient of determination ≥0.50,
THEN calculate average regression line characteristics
ELSE proceed
Access BIVARIATE PLOT DISPLAY routine

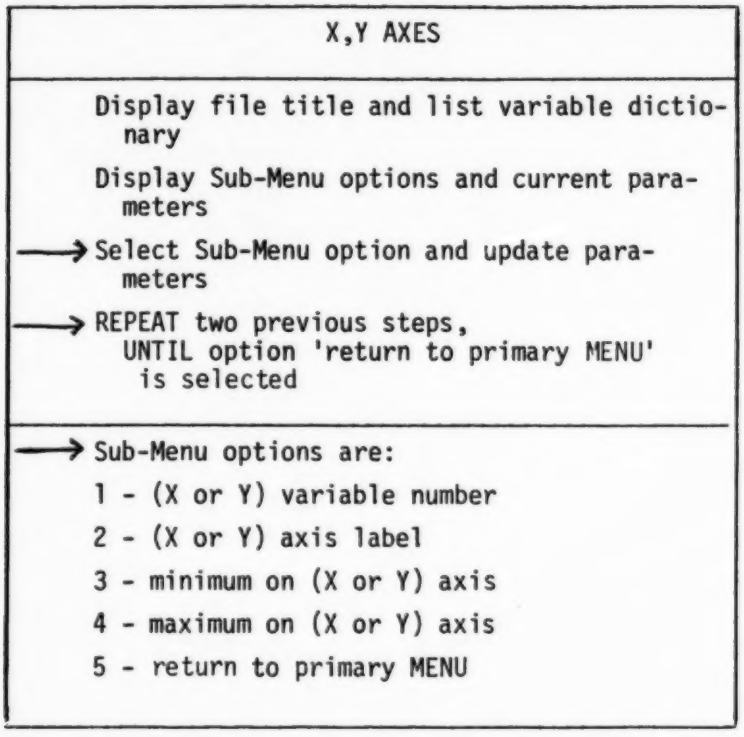
Note: ⟶ indicates that USER input is involved.

Figure 2. Details of the software design. See Figure 1 for the relationship between the various routines detailed here.


BIVARIATE PLOT DISPLAY
Draw bivariate plot on screen
Display file title and number of samples in file
Display subset criteria (if any)
Display X and Y axes identification
Display information on illustrative variable used (if any)
Display number of points plotted
Display correlation coefficient and coefficient of determination, with average regression line equation (if calculated)
→ Access COPY routines, OR access MENU routine
MENU
Identify routine
Display MENU options and current parameters
Display general instructions
→ Update file (project) title OR access Sub-Menus for parameter changes OR exit routine as requested
→ MENU options are (Sub-Menus accessed are listed at right):
1 - data file title
2 - X axis characteristics
3 - Y axis characteristics
X, Y AXES
4 - plot symbol(s)
5 - selection codes
SYMBOL(S)
SUBSET
8 - draw bivariate plot on screen
9 - plot bivariate plot on plotter
10 - exit program

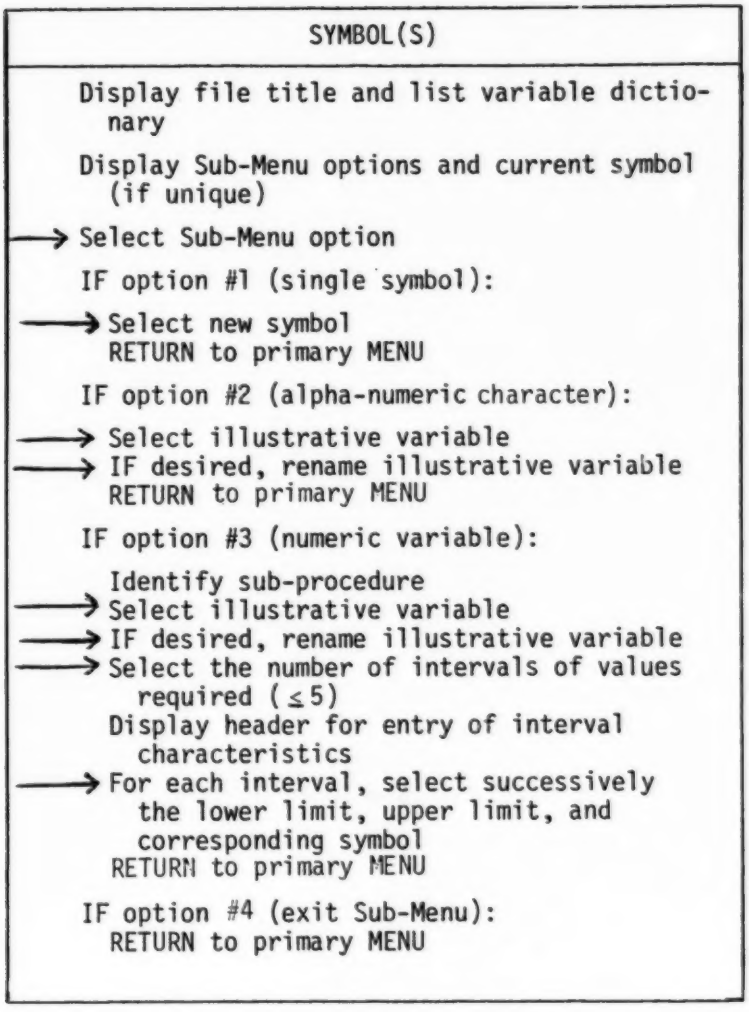
Note: ⟶ indicates that USER input is involved.

Figure 2. Details of the software design. See Figure 1 for the relationship between the various routines detailed here.


X,Y AXES
Display file title and list variable dictionary
Display Sub-Menu options and current parameters
Select Sub-Menu option and update parameters
REPEAT two previous steps, UNTIL option 'return to primary MENU' is selected
Sub-Menu options are:
1 - (X or Y) variable number
2 - (X or Y) axis label
3 - minimum on (X or Y) axis
4 - maximum on (X or Y) axis
5 - return to primary MENU

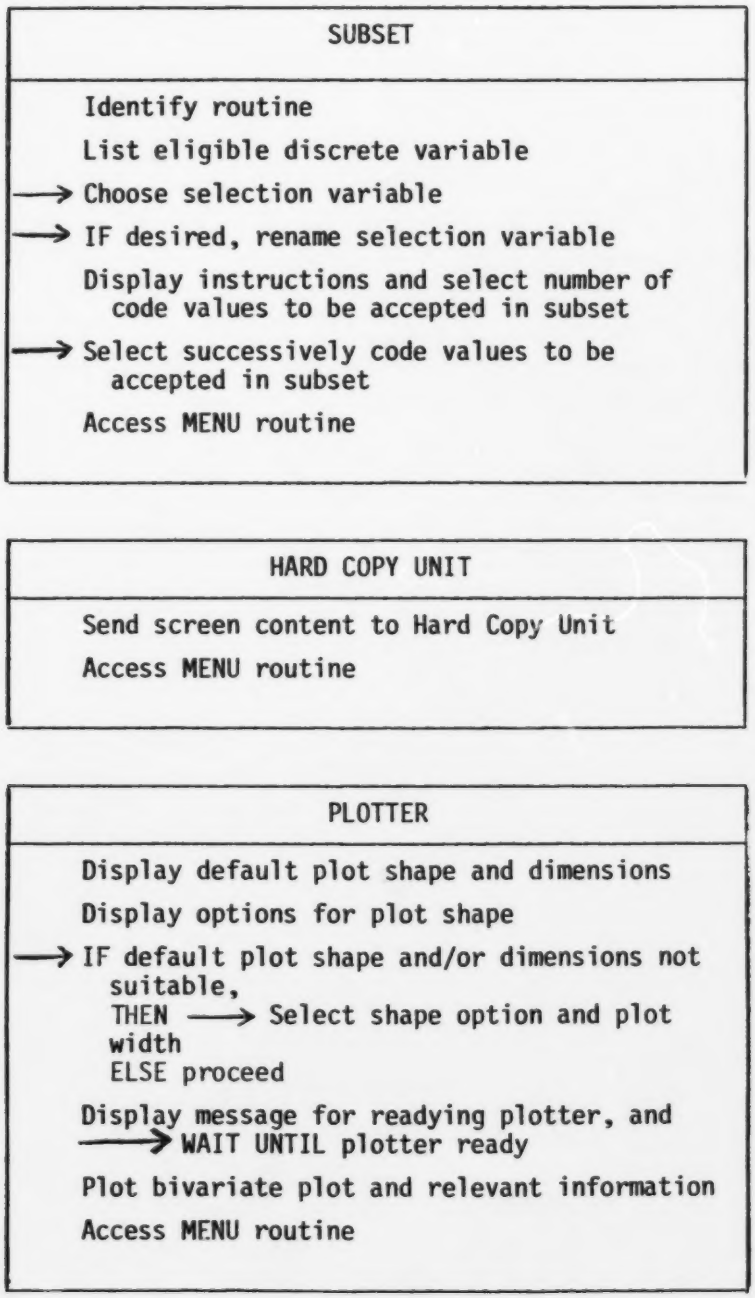
Note: ⟶ indicates that USER input is involved.

Figure 2. Details of the software design. See Figure 1 for the relationship between the various routines detailed here.


SYMBOL(S)
Display file title and list variable dictionary
Display Sub-Menu options and current symbol (if unique)
Select Sub-Menu option
IF option #1 (single symbol):
Select new symbol
RETURN to primary MENU
IF option #2 (alpha-numeric character):
Select illustrative variable
IF desired, rename illustrative variable
RETURN to primary MENU
IF option #3 (numeric variable):
Identify sub-procedure
Select illustrative variable
IF desired, rename illustrative variable
Select the number of intervals of values required (≤5)
Display header for entry of interval characteristics
For each interval, select successively the lower limit, upper limit, and corresponding symbol
RETURN to primary MENU
IF option #4 (exit Sub-Menu):
RETURN to primary MENU

Note: ⟶ indicates that USER input is involved.

Figure 2. Details of the software design. See Figure 1 for the relationship between the various routines detailed here.


SUBSET
Identify routine
List eligible discrete variable
Choose selection variable
IF desired, rename selection variable
Display instructions and select number of code values to be accepted in subset
Select successively code values to be accepted in subset
Access MENU routine
HARD COPY UNIT
Send screen content to Hard Copy Unit
Access MENU routine
PLOTTER
Display default plot shape and dimensions
Display options for plot shape
IF default plot shape and/or dimensions not suitable,
THEN ⟶ Select shape option and plot width
ELSE proceed
Display message for readying plotter, and
⟶ WAIT UNTIL plotter ready
Plot bivariate plot and relevant information
Access MENU routine

Note: ⟶ indicates that USER input is involved.

Figure 2. Details of the software design. See Figure 1 for the relationship between the various routines detailed here.

II. GETTING STARTED

II.1. HOW TO USE THIS GUIDE

This guide is composed of hard copies of the computer screen content (left pages) and of one or more pages of explanations (right pages), all grouped in Chapter III.

Salient details of the screen contents are numbered, and explained successively; these numbers are circled, e.g.: ③ . Computer-generated text is self-explanatory; the user's entries used as examples are boxed, e.g.: [30] .

Screen Contents are presented in order of execution for a typical mode of operation. Particular options are explained next. Figure 3 summarizes the Screen Contents covered and their relationships.

II.2. HOW TO RUN THE PROGRAM

If the system must be started from power up, the user must be familiar enough with the Tektronix 4051 graphics computer to be able to load the Bivariate Plot program into core memory.

Once the Bivariate Plot program is in core memory, it is initialized by entering RUN from the keyboard. The Bivariate Plot program is now in control of the operations and will prompt the user as necessary, starting with SCREEN CONTENT #1. The user must have the data file ready for use on the Auxiliary Memory Module (or another mass storage unit) at this point.

NOTE: The Bivariate Plot program must be initialized (i.e., re-RUN) every time a new data file is examined.

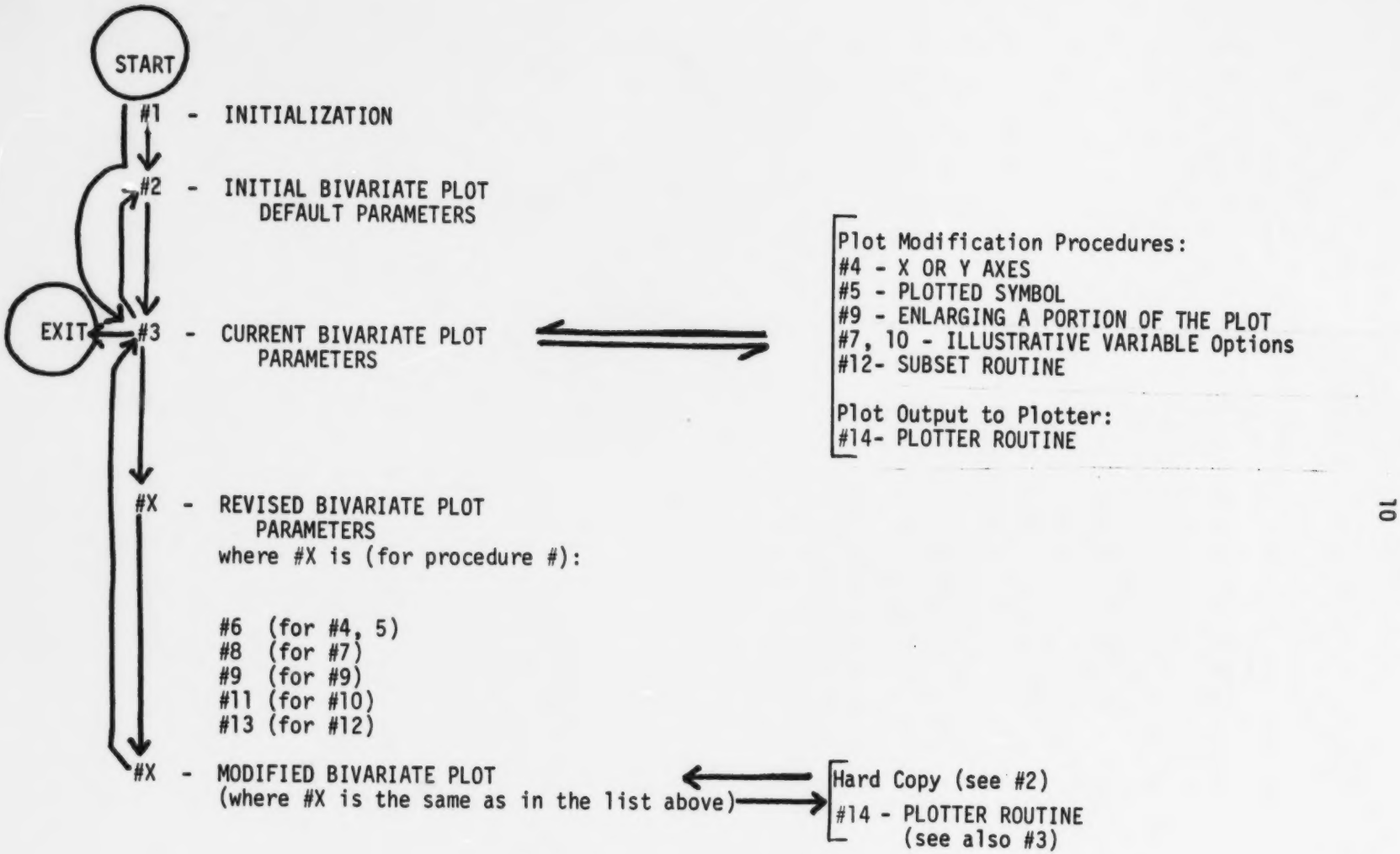


Figure 3. Screen Contents (identified by #) and their relationships.

III. PROGRAM OPERATION

(Note: an explanation of the format and notations of Chapter III is given in Section II.1).

```
BIVARIATE PLOT, SCREEN OR PLOTTER

BOTH PLOTTER AND HARD COPY UNIT MUST BE ON
PAIRS OF NUMERIC VARIABLES ARE PLOTTED
DATA MAY BE SELECTED USING A CODED VARIABLE
A THIRD (ILLUSTRATIVE) VARIABLE MAY BE DESIGNATED

ENTER INPUT DATA FILE #91

FILE TITLE: MLECA81

 1 SAM1    2 SAM2    3 SAM3    4 NROK    5 CORX    6 CORY    7 CORZ
 8 FLAG    9 UNIT   10 SUBU   11 IROK   12 META   13 TEXT   14 FACS
15 CL29   16 CL30   17 SIOX   18 TIOX   19 ALOX   20 CAOX   21 KOX
22 MGOX   23 FE2X   24 FE3X   25 HOX    26 COX    27 NAOX   28 POX
29  MN    30  CU    31  ZN    32  PB    33  NI    34  LI    35  BA
36  RB    37  SR    38  V     39  CO    40  AS    41  AG    42  U
43  MO    44  B

DATA FILE HAS 167 ROWS OF 44 VARIABLES(COLUMNS)

ENTER AXES CHOICE(X,Y): EG. 1,3 17,19

SIOX                ALOX

DO YOU WISH TO PRESCRIBE PLOT PARAMETERS NOW? Y/N N

READING DATA
```

1 2 3 4 5 6 7

SCREEN CONTENT #1 - Initialization

① The program identifies itself and gives general instructions to the user.

② The PROGRAM then prompts the user to identify the input data file by number. The input data file # is the file # of the Header file from a binary data file set Header and Data, or the unique file # if these two files were merged on disk or RAM-disk. The USER enters the input data file # (File #91 is used here).

③ The program displays the characteristics of the data file: the file title, a list of the variables and their index numbers (the file dictionary), the size of the file.

④ The PROGRAM prompts the user to select the plot variables by index number.

The USER enters the index numbers (variables #17 and 19 were selected here, as X and Y axes respectively).

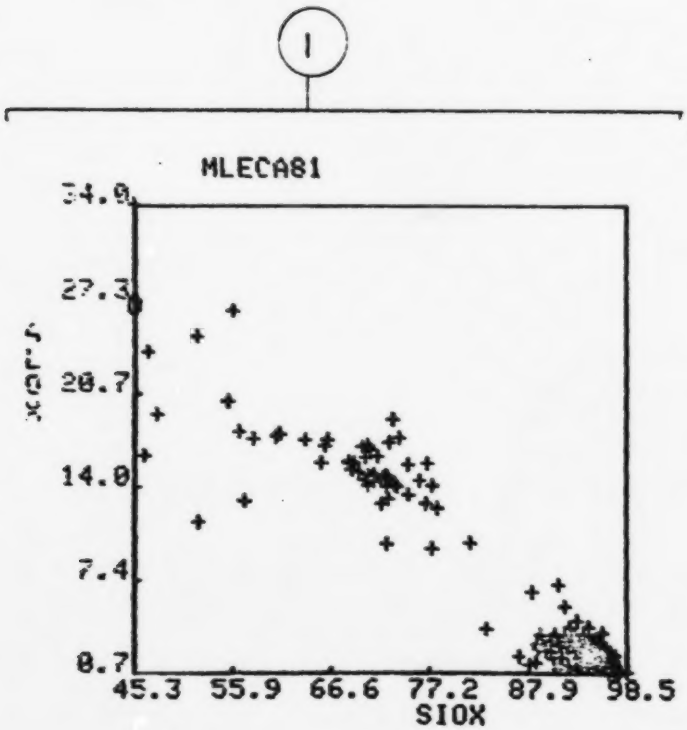
⑤ The program confirms the selection by displaying the names of the variables.

⑥ The PROGRAM then prompts the user to prescribe plot parameters. A positive response (Y) causes the program to branch to the Current Plot Parameter menu, which is explained starting in section SCREEN CONTENT #4.

The USER enters Y or N (N was entered here).

⑦ The program then flashes the phrase READING DATA until the input file is read. The program proceeds to draw the bivariate diagram, assuming default parameters (see SCREEN CONTENT #2).

NOTE: If the message 'NO RANGE IN VARIABLE name' appears after Step⑦ the program will prompt the user to select another variable.



MLECA81

(NUMBER OF SAMPLES: 167)

ALOX vs SIOX

POINTS PLOTTED 167

R=-0.947 R2=0.896
ALOX= +50.09 -0.51SIOX

DO YOU WANT A COPY? Y/N [N]

SCREEN CONTENT #2 - Initial Bivariate Plot, Default Parameters

NOTE: The default parameters of the program are:

- use minimum and maximum of input data for each axis;
- use file and variable names as in file dictionary;
- use '+' as symbol on plot.

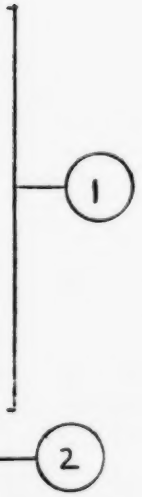
① The bivariate diagram is drawn and annotated with a title and axes labels. The intercepts of the calculated line of regression for the data are plotted as 'O' symbols on the frame of the plot.

② The program then lists the title, the number of samples in the input data population, the variable names and the number of points plotted in the diagram. The correlation coefficient (R) and the coefficient of determination (R2) are also listed. The equation of the average(*) line of regression for the data is calculated and expressed as Y=f(x) only when the coefficient of determination R2 is greater than or equal to 0.50 ($|R| \geq 0.707$).

③ The PROGRAM prompts the user to have a copy of the plot made. A positive response (Y) from the USER produces a second request: HARD COPY or PLOT to appear. IF the USER responds H (hard copy), the plot is copied to the electrostatic copier. A P (plot) response initiates the PLOTTER ROUTINE which draws the plot on the 4662 flatbed plotter. This routine is explained in SCREEN CONTENT #14.
The program will produce copies if and as, requested; it then displays the Current Plot Parameters (primary menu) (see SCREEN CONTENT #3).

(*) NOTE: The regression line is calculated for all data included in the plot. The equation of the regression line displayed is the average of the X-on-Y and Y-on-X regression calculations. It is calculated only when $R2 \geq 0.50$, i.e., when $|R| \geq 0.707$.

```
CURRENT PLOT PARAMETERS

1 - TITLE MLECA81

      VAR#    NAME        ACTUAL              PLOT
                       MINIMUM MAXIMUM   MINIMUM MAXIMUM
2 - X    17    SIOX       45.3    98.5      45.3    98.5
3 - Y    19    ALOX        0.7    34.0       0.7    34.0
4 - SYMBOL ON PLOT  +
    ILLUSTRATIVE VARIABLE  NONE
5 - SELECTION CODES
8 - PLOT ON SCREEN
9 - PLOT ON 4662 PLOTTER
10 - EXIT PROGRAM

YOU MAY SET NEW PARAMETERS OR EXIT PROGRAM
TO CHANGE A PARAMETER, ENTER THE APPROPRIATE NUMERAL [2]
```



SCREEN CONTENT #3 - Current Plot Parameters

① The program displays the current plot parameters in a menu form.

② The PROGRAM then displays instructions for modification of the parameters.

The USER enters the numeral label of the parameter to be changed. The following options are available when the user enters the corresponding numeral:

1...the program prompts for a new title to be entered;

2...X-axis parameters may be modified;

3...Y-axis parameters may be modified;

(Note: modification of axis parameters will be explained in the next section, SCREEN CONTENT #4).

4...the plot symbol may be modified (see SCREEN CONTENT #5).

5...data to be included in the plot may be selected using descriptive codes (see SCREEN CONTENT #12).

8...the program draws the plot on the screen.

9...the program draws the plot directly on the 4662 plotter (see SCREEN CONTENT #14).

10...the program ends.

NOTE: The PROGRAM updates the menu after each modification by the USER, until the user selects menu option 8, 9 or 10. Examples of revised menu parameters are given in SCREEN CONTENTs #6, 8, 9, 11 and 13 for various menu options.

```
FILE TITLE:  MLECA81
  1 SAM1    2 SAM2    3 SAM3    4 HROK    5 CORX    6 CORY    7 CORZ
  8 FLAG    9 UNIT   10 SUBU   11 IROK   12 META   13 TEXT   14 FACS
 15 CL29   16 CL30   17 SIOX   18 TIOX   19 ALOX   20 CAOX   21 KOX
 22 MGOX   23 FE2X   24 FE3X   25 HOX    26 COX    27 NAOX   28 POX
 29  MN    30  CU    31  ZN    32  PB    33  NI    34  LI    35  BA
 36  RB    37  SR    38  V     39  CO    40  AS    41  AG    42  U
 43  MO    44  B
1 - X VARIABLE 17
2 - AXIS LABEL  SIOX
3 - MINIMUM 45.3
4 - MAXIMUM 98.5
5 - RETURN TO PRIMARY MENU      ENTER OPTION 2
....ENTER X AXIS LABEL SIO2

1 - X VARIABLE 17
2 - AXIS LABEL  SIO2
3 - MINIMUM 45.3
4 - MAXIMUM 98.5
5 - RETURN TO PRIMARY MENU      ENTER OPTION 3
....ENTER X MINIMUM 45

1 - X VARIABLE 17
2 - AXIS LABEL  SIO2
3 - MINIMUM 45
4 - MAXIMUM 98.5
5 - RETURN TO PRIMARY MENU      ENTER OPTION 4
....ENTER X MAXIMUM 100

1 - X VARIABLE 17
2 - AXIS LABEL  SIO2
3 - MINIMUM 45
4 - MAXIMUM 100
5 - RETURN TO PRIMARY MENU      ENTER OPTION 5
```

(1) (2) (3) (4)

SCREEN CONTENT #4 - Modifying the X or Y axis Characteristics

The USER has selected option 2 (X) from the primary menu (option 3, Y, would have a similar effect, but on the Y axis):

① The program displays the file title and a list of the variables with their index numbers.

② The PROGRAM lists a sub-menu describing the possible changes the user may make:

1...the variable may be replaced;

2...the axis label may be changed;

3...the minimum value displayed on the axis may be changed;

4...the maximum value displayed on the axis may be changed;

5...the user may return to the primary menu.

③ In our example:

The USER first selects option 2,

The PROGRAM prompts for the new axis label, and the USER enters SI02.

The PROGRAM repeats the sub-menu after a change is completed, and incorporates all changes.

The USER has then made the following successive changes:

- the minimum of the X axis is set to 45.0
- the maximum of the Y axis is set to 100.0

④ Finally, the sub-menu is exited and the USER returns to the primary menu (see SCREEN CONTENT #6 for the updated menu).

```
FILE TITLE: MLECA81
 1 SAM1    2 SAM2    3 SAM3    4 NROK    5 CORX    6 CORY    7 CORZ
 8 FLAG    9 UNIT   10 SUBU   11 IROK   12 META   13 TEXT   14 FACS
15 CL29   16 CL30   17 SIOX   18 TIOX   19 ALOX   20 CAOX   21 KOX
22 MGOX   23 FE2X   24 FE3X   25 HOX    26 COX    27 NAOX   28 POX
29  MN    30  CU    31  ZN    32  PB    33  NI    34  LI    35  BA
36  RB    37  SR    38  V     39  CO    40  AS    41  AG    42  U
43  HO    44  B
PLOT SYMBOL(S) - SELECT OPTION
1 - SUBSTITUTE SINGLE SYMBOL: CURRENT SYMBOL= +
2 - ALPHA/NUMERIC CHARACTERS
3 - NUMERIC VARIABLE
4 - RETURN TO PRIMARY MENU      ENTER OPTION 1
....ENTER SUBSTITUTE SYMBOL 0
```

(1) (2) (3) (4)

SCREEN CONTENT #5 - Modifying the Plotted Symbol

The USER has selected option 4 (SYMBOL ON PLOT) from the primary menu:

(1) The program lists the file title and a list of the variables with their index numbers.

(2) The PROGRAM lists a sub-menu describing options for changing the plotted symbol:

1...the USER may substitute any single symbol (see example below), or

2...any alphabetic or numeric variable may be selected as an illustrative variable (see SCREEN CONTENTs #7 and 8), or

3...any numeric variable may be selected as an illustrative variable for specified ranges of its values (see SCREEN CONTENTs #10 and 11), or

4...the USER may return to the primary menu.

(3) The USER is prompted to select an option (1 was entered here to change the plotted symbol).

(4) The PROGRAM prompts the user to enter the new symbol.

The USER enters the new symbol (0 was entered here as new symbol).

NOTE: the program automatically returns to the primary menu after the expected action has been taken by the user (see SCREEN CONTENT #6 for the updated menu).

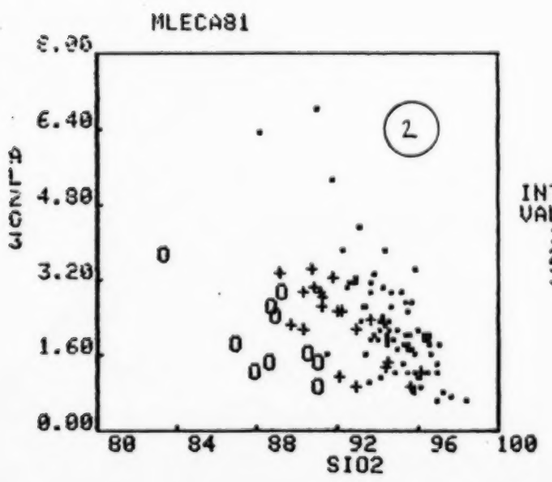
```
CURRENT PLOT PARAMETERS
1 - TITLE MLECA81
        VAR#    NAME        ACTUAL              PLOT
                         MINIMUM MAXIMUM   MINIMUM MAXIMUM
2 - X     17    SIO2        45.3    98.5      80.0   100.0
3 - Y     19    AL203        0.7    34.0       0.0     8.0
4 - SYMBOL ON PLOT
    ILLUSTRATIVE VARIABLE  FE203  SYMBOLS .  +  0
5 - SELECTION CODES
8 - PLOT ON SCREEN
9 - PLOT ON 4662 PLOTTER
10 - EXIT PROGRAM

YOU MAY SET NEW PARAMETERS OR EXIT PROGRAM
TO CHANGE A PARAMETER, ENTER THE APPROPRIATE NUMERAL 8
```

(1)

SCREEN CONTENT #11 - Modified Bivariate Plot: Continuous Illustrative Variable

The program displays the current plot parameters, after changes were made as shown in SCREEN CONTENT #7:

(1) The current plot parameters now include the name of the illustrative variable and the plot symbols that were defined by the user.



MLECA81

(NUMBER OF SAMPLES: 167)

AL203 vs SIO2

ILL. VARIABLE FE203 (3)

INTERVAL #	LOWER LIMIT	UPPER LIMIT	SYMBOL	POINTS PLOTTED
1	0.0	2.0	.	81
2	2.0	5.0	+	20
3	5.0	10.0	0	10

POINTS PLOTTED 111

R=-0.435 R2=0.190

DO YOU WANT A COPY? Y/N N

The new bivariate plot is displayed on a new screen after the USER selected option 8 of the primary menu. It is shown here at the bottom of the page at left:

(2) The symbols plotted represent the intervals of values of the continuous illustrative variable as defined in SCREEN CONTENT #10.

(3) The title block now also contains the name of the illustrative variable used, a list of the interval limits and symbols for this illustrative variable, and a detailed sample count - NOTE that only those samples which fall into one of the intervals are included in the plot (in our example, no sample was excluded).

NOTE: compare the bivariate plot at left with the plot shown in SCREEN CONTENT #9. An explanation for the dispersion of samples away from the overall negative correlation trend can be found in Fe_2O_3, as illustrated in the plot here.

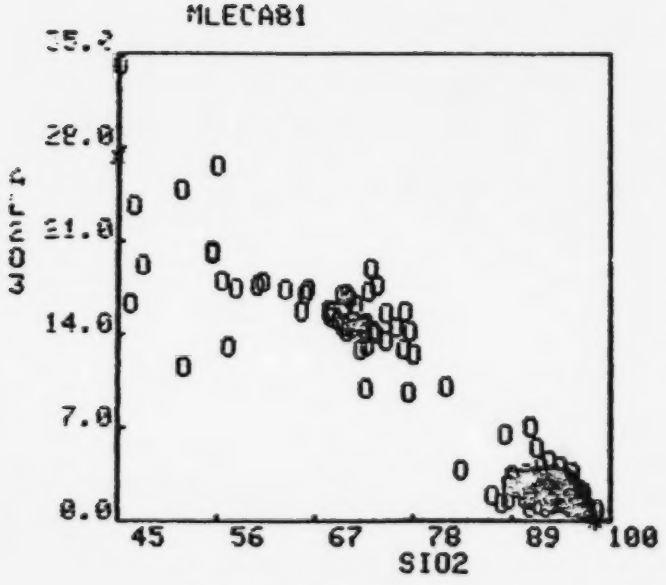
CURRENT PLOT PARAMETERS

1 - TITLE MLECA81

	VAR#	NAME	ACTUAL MINIMUM	ACTUAL MAXIMUM	PLOT MINIMUM	PLOT MAXIMUM
2 - X	17	SI02	45.3	98.5	45.0	100.0
3 - Y	19	AL203	0.7	34.0	0.0	35.0

4 - SYMBOL ON PLOT 0
ILLUSTRATIVE VARIABLE NONE
5 - SELECTION CODES
8 - PLOT ON SCREEN
9 - PLOT ON 4662 PLOTTER
10 - EXIT PROGRAM

YOU MAY SET NEW PARAMETERS OR EXIT PROGRAM
TO CHANGE A PARAMETER, ENTER THE APPROPRIATE NUMERAL



MLECA81

(NUMBER OF SAMPLES: 167)

AL203 vs SI02

POINTS PLOTTED 167

R=-0.947 R2=0.896
AL203= +50.09 -0.51SI0

DO YOU WANT A COPY? Y/N N

SCREEN CONTENT #6 - Example of Revised Plot Parameters and Modified Bivariate Plot

The program displays the current plot parameters in menu form after changes were made as shown in SCREEN CONTENTs #4 and #5 (additional changes have been incorporated, as explained below):

① Revised parameters for the X axis are: the name is now SI02, the plot minimum 45.0, and the maximum 100.0, as a result of the action described in SCREEN CONTENT #4.

② Similar revisions have been applied to the Y axis: the new name is AL203, the new plot miminum 0.0, and the new maximum 35.0 (compare with SCREEN CONTENT #3).

③ The plot symbol is now '0', as prescribed in SCREEN CONTENT #5.

These modifications are incorporated in the new bivariate plot, as shown at the bottom of the page (compare with SCREEN CONTENT #2).

NOTE: well-separated populations appear on the plot shown at left. The user may wish to relate such sub-populations to some characteristic of the samples that was coded in the data file. This is done in the next two sections, SCREEN CONTENTs #7 and 8.

```
FILE TITLE: MLECA81
 1 SAM1    2 SAM2    3 SAM3    4 NROK    5 CORX    6 CORY    7 CORZ
 8 FLAG    9 UNIT   10 SUBU   11 IROK   12 META   13 TEXT   14 FACS
15 CL29   16 CL30   17 SIOX   18 TIOX   19 ALOX   20 CAOX   21 KOX
22 MGOX   23 FE2X   24 FE3X   25 HOX    26 COX    27 NAOX   28 POX
29  MN    30  CU    31  ZN    32  PB    33  NI    34  LI    35  BA
36  RB    37  SR    38  V     39  CO    40  AS    41  AG    42  U
43  MO    44  B
PLOT SYMBOL(S) - SELECT OPTION
1 - SUBSTITUTE SINGLE SYMBOL: CURRENT SYMBOL= 0
2 - ALPHA/NUMERIC CHARACTERS
3 - NUMERIC VARIABLE
4 - RETURN TO PRIMARY MENU     ENTER OPTION 2

ENTER INDEX# FOR ILLUSTRATIVE VARIABLE 9

ILLUSTRATIVE VARIABLE = UNIT  RENAME? Y/N N
```

(1) (2) (3) (4)

SCREEN CONTENT #7 - Defining an Illustrative Variable Using an Alpha-numeric or Discrete Variable

The USER has selected option 4 (ILLUSTRATIVE VARIABLE) from the primary menu:

① The program displays the file title and a list of the variables with their index numbers.

② The sub-menu for the definition of plot symbol(s) is displayed.
The PROGRAM prompts the user to select an option.
The USER enters the selected option (2 was entered here: the symbol plotted on the bivariate diagram will be the actual value of the variable selected in the next step).

③ The PROGRAM prompts the user to enter the index # of the illustrative variable to be used.
The USER enters the index # of the selected illustrative variable (variable #9, UNIT, will be used here).

④ The PROGRAM prompts the user to rename the variable if desired.
If the USER enters Y, then the PROGRAM will prompt the USER for the new name. (The USER entered N here, so that the present variable name will be kept).

NOTE: the program returns automatically to the primary menu after the last prompt was answered - see SCREEN CONTENT #8.

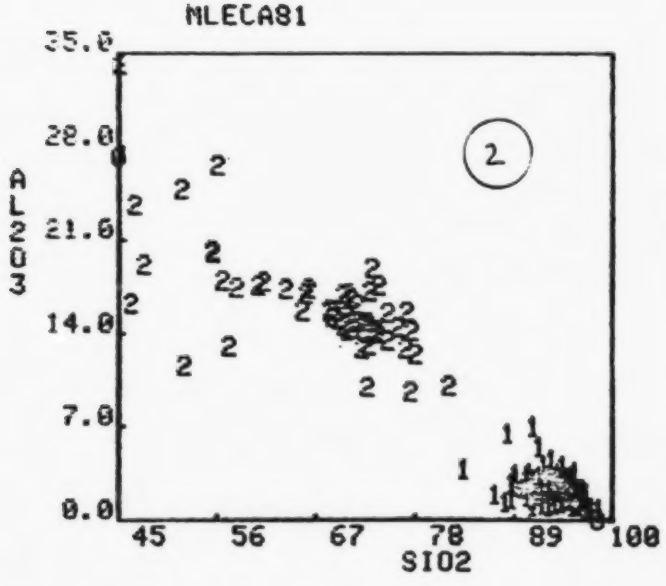
CURRENT PLOT PARAMETERS

1 - TITLE MLECA81

	VAR#	NAME	ACTUAL MINIMUM	ACTUAL MAXIMUM	PLOT MINIMUM	PLOT MAXIMUM
2 - X	17	SIO2	45.3	98.5	45.0	100.0
3 - Y	19	AL203	0.7	34.0	0.0	35.0

4 - SYMBOL ON PLOT
ILLUSTRATIVE VARIABLE UNIT — (1)
5 - SELECTION CODES
8 - PLOT ON SCREEN
9 - PLOT ON 4662 PLOTTER
10 - EXIT PROGRAM

YOU MAY SET NEW PARAMETERS OR EXIT PROGRAM
TO CHANGE A PARAMETER, ENTER THE APPROPRIATE NUMERAL [8]



MLECA81

(NUMBER OF SAMPLES: 167)

AL203 vs SIO2

ILL. VARIABLE UNIT — (3)
POINTS PLOTTED 167

R=-0.947 R2=0.896
AL203= +50.09 -0.51SIO2

DO YOU WANT A COPY? Y/N [N]

SCREEN CONTENT #8 - Modified Bivariate Plot: Alpha-Numeric or Discrete Illustrative Variable

The Program displays the current plot parameters after the changes were made as shown in SCREEN CONTENT #7.

① UNIT is listed as the illustrative variable. No symbol is shown in this case: the actual values of this variable will be displayed on the plot.

The new bivariate plot is displayed on a refreshed screen after the USER selected option 8 of the primary menu. It is shown here at the bottom of the page at left:

② The symbols plotted in the diagram represent the actual values of the illustrative variable UNIT (1 and 2, here).

③ The illustrative variable is now listed in the title block in addition to the other information (compare with the plot of SCREEN CONTENT #6).

NOTE: in order to illustrate adequately the remaining options available to the user, we will now concentrate our attention on the sub-population located at the lower right of the plot (high silica content, low alumina content) - see SCREEN CONTENT #9.

CURRENT PLOT PARAMETERS

1 - TITLE MLECA81

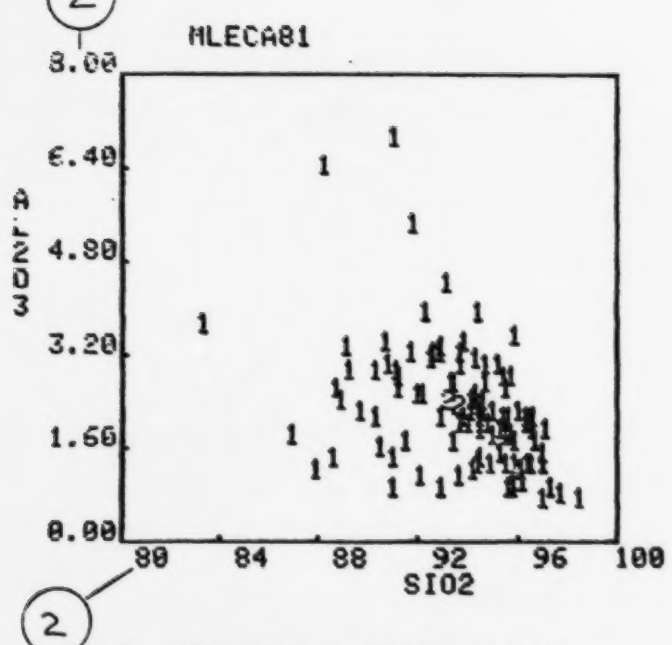
	VAR#	NAME	ACTUAL MINIMUM	ACTUAL MAXIMUM	PLOT MINIMUM	PLOT MAXIMUM
2 - X	17	SI02	45.3	98.5	80.0	100.0
3 - Y	19	AL203	0.7	34.0	0.0	8.0

(1)

4 - SYMBOL ON PLOT
ILLUSTRATIVE VARIABLE UNIT
5 - SELECTION CODES
8 - PLOT ON SCREEN
9 - PLOT ON 4662 PLOTTER
10 - EXIT PROGRAM

YOU MAY SET NEW PARAMETERS OR EXIT PROGRAM
TO CHANGE A PARAMETER, ENTER THE APPROPRIATE NUMERAL 8

(2)



(2)

DO YOU WANT A COPY? Y/N N

MLECA81

(NUMBER OF SAMPLES: 167)

AL203 vs SI02

ILL. VARIABLE UNIT
POINTS PLOTTED 111

(3)

R=-0.435 R2=0.190

SCREEN CONTENT #9 - Enlarging a Portion of the Bivariate Plot

After examination of SCREEN CONTENT #8, the USER decided to concentrate on one sub-population. This was accomplished simply by redefining the X and Y axes using the procedure explained in SCREEN CONTENT #4. The new plot parameters are shown here:

① The new minimum on the X axis (SI02) is 80.0, whereas the new maximum on the Y axis (AL203) was set at 8.0 (compare with SCREEN CONTENT #8).

The USER then asked for the new plot to be displayed; this plot is shown here at the bottom of the page at left:

② The new minimum for SI02 and maximum for AL203 are implemented, thus enlarging the lower right corner of the diagram shown in SCREEN CONTENT #8.

③ Only 111 samples are displayed, which belong to the sub-population of interest to the user. One may note that most of those samples correspond to UNIT=1, with very few samples with UNIT=2.

NOTE: a further study of this sub-population may involve explaining dispersion of the samples away from the general trend, for example. This can be accomplished by making further use of illustrative variables (see SCREEN CONTENTs #10 and 11), or by selecting samples according to some selection code (see SCREEN CONTENTs #12 and 13).

```
FILE TITLE: MLECA81
 1 SAM1    2 SAM2    3 SAM3    4 NROK    5 CORX    6 CORY    7 CORZ
 8 FLAG    9 UNIT   10 SUBU   11 IROK   12 META   13 TEXT   14 FACS
15 CL35   16 CL30   17 SIOX   18 TIOX   19 ALOX   20 CAOX   21 KOX
22 MGOX   23 FE2X   24 FE3X   25 HOX    26 COX    27 NAOX   28 POX
29  MN    30  CU    31  ZN    32  PB    33  NI    34  LI    35  BA
36  RB    37  SR    38  V     39  CO    40  AS    41  AG    42  U
43  MO    44  B
PLOT SYMBOL(S) - SELECT OPTION
1 - SUBSTITUTE SINGLE SYMBOL: CURRENT SYMBOL= +
2 - ALPHA/NUMERIC CHARACTERS
3 - NUMERIC VARIABLE
4 - RETURN TO PRIMARY MENU      ENTER OPTION 3

NUMERIC CLASSIFICATION

ENTER INDEX# FOR ILLUSTRATIVE VARIABLE 24

ILLUSTRATIVE VARIABLE = FE3X  RENAME? Y/N Y
ENTER NEW NAME FE203

ENTER NUMBER OF INTERVALS(5 OR FEWER) 3
ENTER INTERVAL LIMITS AND SYMBOLS
INTERVAL LOWER UPPER SYMBOL
   #     LIMIT LIMIT
   1     0.0   2.0     .
   2     2.0   5.0     +
   3     5.0   10.0    0
```

(1) (2) (3) (4) (5) (6) (7) (8)

SCREEN CONTENT #10 - Defining an Illustrative Variable Using a Continuous Variable

The USER has selected option 4 (ILLUSTRATIVE VARIABLE) from the primary menu:

① The program lists the file title and a list of the variables with their index numbers.

② The plot symbol modification sub-menu is listed. The PROGRAM prompts the user to select an option. The USER in this case selects option 3 for numeric variables.

③ The program indicates that the NUMERIC CLASSIFICATION option has been selected.

④ The PROGRAM prompts the user to enter the index # of the illustrative variable.

The USER enters the index number of the selected illustrative variable (variable #24, FE3X, is selected here).

⑤ The PROGRAM lists the name of the illustrative variable and prompts the user to rename the variable if desired.

If the USER enters N, then the program proceeds to step ⑦.

If the USER enters Y (as is done here), then:

⑥ The PROGRAM prompts the user for the new variable name.

The USER enters the new name FE203, the actual name of the variable, is entered here).

⑦ The program prompts the user to enter the number of intervals for which symbols will be defined.

The USER enters the number of required intervals (3 intervals will be used here).

⑧ The PROGRAM instructs the user to define the intervals and prompts each in turn.

(continued)

The USER enters successively the lower limit, upper limit and the corresponding symbol for each of the three intervals. After each item is typed on the keyboard, hitting 'RETURN' will prompt the next item until all information has been entered. The program then returns automatically to the primary menu, after the last 'RETURN' has been keyed in.

The result of this option on the primary menu and the bivariate plot are explained in SCREEN CONTENT #11.

NOTES: (1) this sub-menu option for defining an illustrative variable using successive intervals has been designed for continuous variables. However, this option may also be used for discrete variables, instead of option 2 described in SCREEN CONTENTs #7 and 8, for example if symbols are required or if a few intervals are more suitable then several discrete values.

(2) a maximum of 5 intervals may be defined under option 3 of this sub-menu. It is possible to run successive plots if more than 5 intervals are relevant for a particular illustrative variable, because only those samples which fall into one of the defined intervals are plotted; other samples are not included.

```
DATA SELECTION ON CODED VARIABLE                                    (1)

 5 CORX   6 CORY   7 CORZ   8 FLAG   9 UNIT  10 SUBU  11 IROK  12 META
13 TEXT  14 FACS  15 CL29  16 CL30

ENTER SELECTION VARIABLE INDEX # 14                                 (3)

SUBSET VARIABLE IS FACS  RENAME? Y/N Y                              (4)
ENTER NEW NAME FACIES

YOU MAY SELECT DATA ON UP TO 3 DISCRETE NUMERIC CODES               (5)
ENTER NUMBER OF CODES 2
ENTER CODE VALUE 2
ENTER CODE VALUE 3                                                  (6)
```

(2)

SCREEN CONTENT #12 - Subset Routine

The user has selected option 5 (SELECTION CODES) from the primary menu:

① The program indicates that the data selection or subset routine has been accessed.

② A list of those variables which are eligible to be used for subsetting is displayed.

③ The PROGRAM prompts the user to enter the index # of the subsetting variable.

The USER enters the variable # (variable #14, FACS, has been chosen here.

④ The PROGRAM prompts the user to rename the subset variable as desired.

If the USER enters N, then the program proceeds to step ⑤.

If the USER enters Y (as is done here), then the PROGRAM prompts for the new variable name and the USER enters it (FACIES was entered here).

⑤ The PROGRAM requests the user to enter the number of discrete code values that will be used for including samples in the subset.

The USER enters the number of code values required (2 code values will be used here).

⑥ The PROGRAM then prompts the user to enter these code values in succession.

The USER enters the code values, one after each prompt, and the program returns automatically to the primary menu after all

(continued)

information has been entered.

The modified primary menu parameters and the resulting plot are shown in SCREEN CONTENT #13.

NOTE: Once the Subset Routine has been entered and the subset criteria defined, these criteria can only be modified and cannot be cancelled to return to the total population. Thus, a study of the total population is expected to be carried out first, or independently. Reversible subsetting, or sample selection, can be achieved for each plot through the use of the numeric illustrative variable option (see SCREEN CONTENTs #10 and 11).

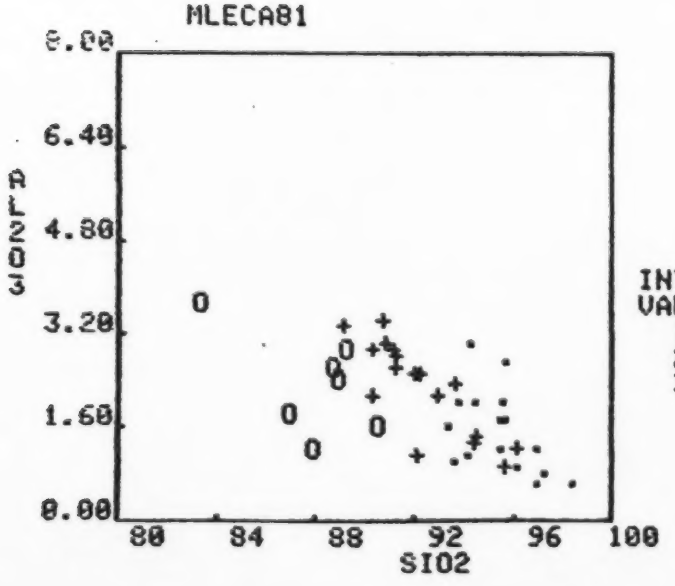
CURRENT PLOT PARAMETERS

1 - TITLE MLECA81

	VAR#	NAME	ACTUAL MINIMUM	ACTUAL MAXIMUM	PLOT MINIMUM	PLOT MAXIMUM
2 - X	17	SIO2	45.3	98.5	80.0	100.0
3 - Y	19	AL203	0.7	34.0	0.0	8.0

4 - SYMBOL ON PLOT
ILLUSTRATIVE VARIABLE FE203 SYMBOLS . + 0
5 - SELECTION CODES FACIES 2, 3 (1)
8 - PLOT ON SCREEN
9 - PLOT ON 4662 PLOTTER
10 - EXIT PROGRAM

YOU MAY SET NEW PARAMETERS OR EXIT PROGRAM
TO CHANGE A PARAMETER, ENTER THE APPROPRIATE NUMERAL [8]



MLECA81

(NUMBER OF SAMPLES: 167)
DATA SCREENING ON
FACIES 2, 3 (2)

AL203 vs SIO2

ILL. VARIABLE FE203

INTERVAL #	LOWER LIMIT	UPPER LIMIT	SYMBOL	POINTS PLOTTED
1	0.0	2.0	.	16
2	2.0	5.0	+	17
3	5.0	10.0	0	7

POINTS PLOTTED 40

R=-0.626 R2=0.392 (3)

DO YOU WANT A COPY? Y/N [Y]
HARD COPY OR PLOT? H/P [P] (4)

SCREEN CONTENT #13 - Modified Bivariate Plot: on a Subset of Samples

The program displays the current plot parameters, after changes were made as shown in SCREEN CONTENT #12:

① The list of revised parameters now contains the name of the sub-setting variable, FACIES, and a list of the values for which samples will be accepted (FACIES = 2 and 3, here).

The new bivariate plot is displayed on a refreshed screen after the USER selected option 8 on the primary menu. It is shown here at the bottom of the page at left.

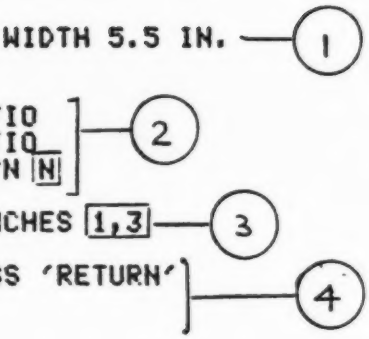
② A message appears which describes the subset criteria (in our case, only samples which have value 2 or 3 for FACIES have been included in the plot).

③ (Compare with the plot of SCREEN CONTENT #11: the number of samples for each interval is reduced, for a new total of 40 samples in the new plot).

④ (The user has chosen to make a pen-plotted copy of this bivariate plot - see the next section, SCREEN CONTENT #14).

NOTE: Compare with the bivariate plot of SCREEN CONTENT #11. It can be noted that a greater proportion of samples which belong to facies 2 and 3 fall into intervals 2 and 3 defined for Fe_2O_3.

```
PLOTTER DIMENSIONS - SHAPE 1:1 WIDTH 5.5 IN.

1 - SQUARE
2 - 2:3 HORIZONTAL/VERTICAL RATIO
3 - 3:2 HORIZONTAL/VERTICAL RATIO
KEEP CURRENT SHAPE AND SIZE? Y/N [N]

CHOOSE SHAPE, ENTER WIDTH IN INCHES [1,3]

WHEN THE PLOTTER IS READY, PRESS 'RETURN'

READING DATA
```



SCREEN CONTENT #14 - Plotter Routine

The USER has selected option 9 (PLOT ON 4662 PLOTTER) from the primary menu. The PROGRAM enters the Plotter Routine:

① The program describes the shape and dimensions of the default bivariate diagram.

② The program lists the alternative diagram shapes that are available. The PROGRAM then requests the user to keep or reject the default shape and dimensions.

If the USER enters Y, then the program proceeds to step ④.

If the USER enters N (as was done here), rejecting the default values, then:

③ The PROGRAM requests the user to enter a shape option and the width of the plot (X axis) in inches.

The USER enters in order the chosen shape option and plot width (in inches). (1 and 3 were entered here: the 1 indicates that a square shape is requested, the 3 indicates that the requested length of the X axis is 3 inches).

④ The PROGRAM prompts the user to have the plotter ready.(*)

The USER presses 'RETURN' when ready(*), and READING DATA is flashed on the screen to indicate that the program is processing the data for the plotter.

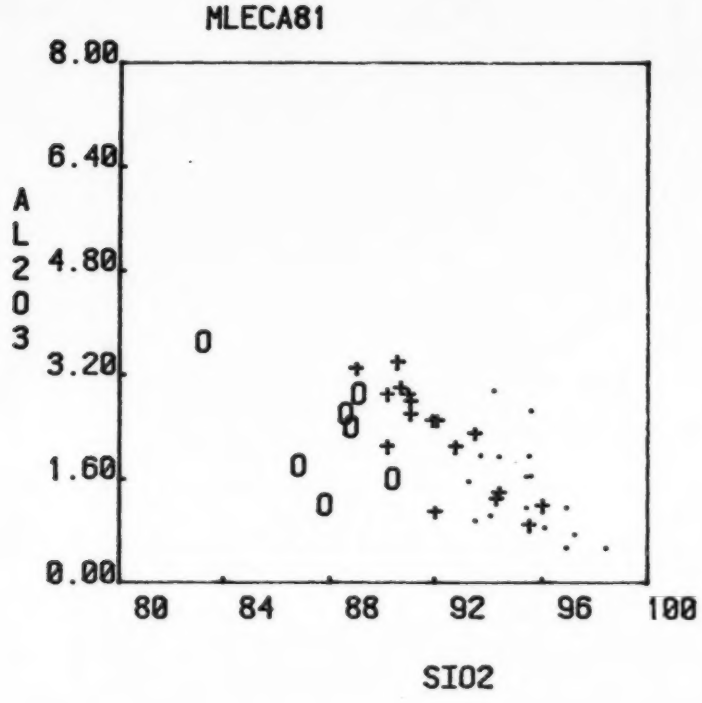
(*) NOTE: the plotter is ready to plot when:

(1) paper is in place, aligned in the lower left corner of the flatbed;

(2) all the grey buttons on the plotter keyboard are in the up-position;

(3) the pen is located in the upper right corner, with its cap off.

5



MLECA81

(NUMBER OF SAMPLES: 167)
DATA SCREENING ON
FACIES 2, 3

AL2O3 vs SIO2

ILL. VARIABLE FE2O3

INTER VAL #	LOWER LIMIT	UPPER LIMIT	SYM BOL	POINTS PLOTTED
1	0.0	2.0	.	16
2	2.0	5.0	+	17
3	5.0	10.0	0	7

POINTS PLOTTED 40
R=-0.626 R2= 0.392

(continued)

⑤ The bivariate plot produced on the flatbed plotter is shown here. It is a replicate of the plot produced on the screen prior to entering the Plotter Routine.

Next, the program returns to the primary menu for further inquiries.